## REMARKS

The Office Action of March 29, 2006 has been received and its contents carefully considered.

Revisions To The Application:

The present Amendment revises independent claim 1 by narrowing the range of the inorganic powder that is recited in the claim. Claim 1 now provides that a resin composition contains "20-50% by weight of an inorganic powder...," instead of "15-50 % by weight of an inorganic powder..." (the previous claim language). This revision to the language of claim 1 is supported (for example) by examples 1-3, which are described in the present application beginning at page 19. It will be noted that the inorganic powder in example 1 is 40% by weight; in example 2 it is 33% by weight; and in example 3 it is 20% by weight. It is respectfully submitted that these examples provide support for the current formulation of claim 1, in which the inorganic powder is not less then 20% by weight.

The present Amendment also adds a new dependent claim 7 to further protect the invention. Claim 7 provides that the content of reinforcing fiber is 20 to 30% by weight. This is supported (for example) by the passage at page 15, line 24 to page 16, line 5, and also by the passage at page 16, lines 10-13.

The Rejections:

Section 3 of the Office Action rejects independent claim 1 (along with two dependent claims) for obviousness on the basis of Japanese publication 2003-172433

(hereafter JP '433) in view of US patent 5,514,748 to Isutsumi et al (hereafter simply Isutsumi). In addition, section 5 of the Office Action rejects claim 1 (and several dependent claims) for obviousness on the basis of Japanese publication 06-322232 (hereafter simply JP '232) and Isutsumi. For the reasons discussed below, however, it is respectfully submitted that the invention now defined by claim 1 is patentable over these references.

As was noted above, claim 1 now recites that the composition contains "20 to 50% by weight of an inorganic powder..." It contrast, the upper limit of the silica powder employed in JP '433 and also in JP '232 is 15%. Neither reference discloses the range now recited in claim 1.

In addition claim 1 recites "20 to 40% by weight of a reinforcing fiber." Thus, 40% by weight is the high end of the range of reinforcing fiber recited in claim 1, while it is the low end of the glass fiber range disclosed in JP '433 and JP '232.

Claim 1 also recites "1 to 5% by weight of fluororesin powder having an average particle diameter of not more than 10 μm." The Office Action acknowledges that neither Japanese reference discloses this average particle size. Instead, the Office Action turns to the particle size disclosed in the Isutsumi reference. However, there is no apparent reason why an ordinarily skilled person who wanted to make an improved pulley would think that Isutsumi's particle size would contribute to this goal.

A pulley is typically used together with a belt in a power-transferring arrangement. In a demanding application such as a vehicle's engine, wear of the pulley and the belt must be considered. Reinforcing fiber in a resin pulley tends to attack the

belt, thus increasing the belt's wear. On the other hand, reinforcing fiber in a resin pulley reinforces the pulley itself.

It the resin pulley defined by claim 1, the reinforcing fiber content is restricted to not more then 40% by weight. This reduces wear of the belt with which the pulley is used. Claim 1 also provides that the pulley has not less then 20% by weight of a hard inorganic powder (with a Mohs hardness of not less then 6.5), which compensates for the reduced content of reinforcing fiber and improves the wear resistance of the pulley. The result is a pulley that is wear-resistant, without exposing the belt to excessive wear. It is respectfully submitted that the references would not have the led a person who had only ordinarily skill in the art to the advantages of the pulley now defined by claim 1.

When the content of reinforcing fiber in a resin pulley is set at not more then 40% by weight in order to restrain the belt-attacking property of the fiber, and the content of hard inorganic powder is less then 20% by weight (instead of 20-40% as recited in claim 1), pulley wear increases abruptly. Evidence of this is provided by a Rule 132 Declaration that is attached to this Amendment. The Declaration reports the results of experiments performed by one of the joint inventors of the present application or people working under his supervision. It is respectfully submitted that the Declaration establishes that using at least 20% by weight of hard inorganic powder, in the pulley now defined by claim1, leads to unexpectedly superior results.

Accordingly, it is respectfully submitted that the invention now defined by claim 1 would not have been obvious, to an ordinarily skilled person, from the references cited in the Office Action. The remaining claims depend from claim 1 and recite additional

limitations to further define the invention, so they are patentable along with claim 1 and need not be further discussed.

Information Disclosure Statement:

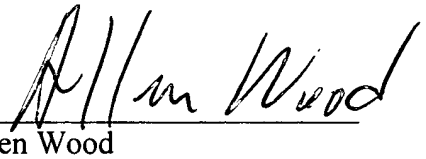
Section 2 of the Office action comments that JP 06-018964 ("Photographic Device, Camera And Fine Adjustment Mechanism") has not been considered because it does not appeared to be relevant to the present application. However, the reference supplied with the Information Disclosure Statement filed August 10, 2005 was Examined patent publication JP 06-018964 B, while "Photographing Device, Camera And Fine Adjustment Mechanism" is the subject matter of Unexamined patent publication JP 06-018964 A. They are not the same.

Another copy of JP 06-018964 B (JP 62-109844 A) is attached, along with a Patent Abstracts Of Japan summary and a machine-generated translation. It is respectfully requested that the reference be considered and listed on a form PTO-892 (since it has already been submitted in an IDS).

Conclusion:

For the foregoing reasons, it is respectfully submitted that this application is now in condition for allowance. Reconsideration of the application is therefore respectfully requested.

Respectfully submitted,



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(56)参考文献　特開　昭55－108485（ＪＰ，Ａ）
特開　昭54－144（ＪＰ，Ａ）
特開　昭61－221254（ＪＰ，Ａ）
特開　昭51－126241（ＪＰ，Ａ）

(54)【発明の名称】　摺動部用部材

1

【特許請求の範囲】

【請求項１】いずれも重量比で、カーボン繊維３～20％、オイルコークス粉末３～20％および残部が四フッ化エチレン樹脂粉末よりなる混合粉末を焼成して得られた摺動部用部材。

【発明の詳細な説明】

〔産業上の利用分野〕

本発明は、摺動部用部材に関する。更に詳しくは、充填剤として金属粉末を含有することなく、耐摩耗性を向上せしめた摺動部用部材に関する。

〔従来の技術〕

四フッ化エチレン樹脂は、耐熱性、耐薬品性、摺動特性などにすぐれているので、シール材として広く用いられているが、これ単独では外力による変形量が大きく、また摩耗量も大きいので、それに種々の充填材を配合することが行われている。

2

充填材としては、ガラス繊維、カーボン繊維、金属粉末などが用いられているが、近年は苛酷な条件下での使用検討が増加し、従来のものでは限界PV値（PV値は、軸受特性を表わすのに用いられ、軸受材の相互比較の目安となるものであり、圧力Ｐと摺動面速度Ｖとの関数で表わされ、この値が高い程耐圧性、耐速度性にすぐれていることになる）が低いため、こうした要求に対して対応ができなくなってきている。また、充填材として金属粉末が用いられると、摩耗粉に金属粉末が含まれてくるため、相手材を傷付けるなどの不具合を生ずることがある。

〔発明が解決しようとする問題点〕

本発明者は、こうした不具合を発生させる可能性のある金属粉末を用いることなく、摺動部用部材の耐摩耗性を

向上せしめる方法を求めて種々の検討を行なった結果、焼成して摺動部用部材を形成せしめる混合粉末の1成分として、オイルコークス粉末を用いることにより、かかる課題が解決されることを見出した。

〔問題点を解決するための手段〕

従って、本発明は摺動部用部材に係り、この摺動部用部材は、いずれも重量比でカーボン繊維3～20%、オイルコークス粉末3～20%および残部が四フッ化エチレン樹脂粉末よりなる混合粉末を焼成して得られる。

カーボン繊維としては、一般に単糸径が約10～15μm、繊維長が約0.1～0.4mmのものが用いられる。オイルコークス粉末は、原油の蒸留工程において生産される石油コークスを粉砕することにより得られ、その粒径が約30～200μmで、不規則な形状の多孔質粒子状のものが用いられる。また、四フッ化エチレン樹脂粉末としては、一般に平均粒径が約30～50μm、平均分子量が約1万～10万のものが用いられる。

規定された各成分間の配合割合は、本発明の目的を達成させるのに有効な範囲であり、各成分共これより少ない割合で用いられると限界PV値を低下させ、またこれより多い割合では機械的強度を低下させるようになる。

以上の各成分からなる混合粉末は、混合機などによってよく混合した後、所定形状の金型に入れ約700～900kgf/cm²の圧力下で予備成形し、この予備成形物は、例えば約3時間かけてその温度を室温から375℃に上げ、この温度で約3時間保持した後、約10時間かけて室温迄戻すというようにして焼成炉中で焼成される。焼成物は、その後所望の形状に加工されて、例えば軸受などの摺動部用部材に成形される。

〔作用〕および〔効果〕

本発明に係る摺動部用部材は、次のような点での特徴を有している。

（1）カーボン繊維とオイルコークス粉末とがからまって、互いに補強し合っているので、得られた摺動部用部材の機械的特性、例えば圧縮強度や限界PV値などを高め＊



＊ることができる。

（2）摺動部用部材の表面にはカーボン繊維とオイルコークス粉末とから微小な凹凸が形成され、更にはオイルコークス粉末表面にも微小な凹凸があり、そこに潤滑用液体を保持せしめることができるので潤滑性能が高く、すぐれた摺動特性を発揮する。

（3）得られた摺動部用部材の耐熱性は高く、260℃での常用が可能であり、耐食性も良好である。また、摩耗粉中に金属粉末が含まれていないため、相手材を傷付けるなどの不具合を生じない。

〔実施例〕

次に、実施例について本発明を説明する。

実施例1～3、比較例1～3

下記表に示される組成（重量部）の混合粉末を、圧縮成形法により予備成形した後、360～380℃で約3時間焼成し、焼成物について摩耗係数の測定を行なった。この測定は、荷重8kg/cm²、速さ0.5 m／秒、時間48時間、相手材 S45C、環境無潤滑の条件下に、鈴木式摩擦摩耗試験機を用いて行われた。得られた結果は、次の表に示される。

表

| | 実施例 | | | 比較例 | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 |
| 〔組成〕 | | | | | | |
| カーボン繊維 | 5 | 10 | 15 | 10 | - | 5 |
| オイルコークス粉末 | 15 | 10 | 5 | - | 20 | - |
| 人造グラファイト（平均粒径100μm以下） | - | - | - | - | - | 15 |
| 四フッ化エチレン樹脂粉末 | 80 | 80 | 80 | 90 | 80 | 80 |
| 〔摩耗係数〕 | | | | | | |
| $10^{-6}$ cm/(kg/cm²)(m/秒)hr | 7.3 | 8.6 | 10.6 | 11.3 | 18.2 | 28.9 |

この結果から、カーボン繊維とオイルコークス粉末とは、相乗効果的に摩耗係数を低下させることが分かる。

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# PATENT ABSTRACTS OF JAPAN

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C08K 7/06
C08K 7/18

(21)Application number : 60-248107
(22)Date of filing : 07.11.1985

(71)Applicant : NOK CORP
(72)Inventor : ITO KAORU

## (54) MEMBER FOR SLIDING PART

(57)Abstract:
PURPOSE: A member for sliding parts, consisting of carbon fibers, oil coke and tetrafluoroethylene resin, having improved abrasion resistance without incorporating metal powder and further excellent mechanical and sliding characteristic, etc.
CONSTITUTION: A member for sliding parts obtained by firing mixed powder consisting of (A) 3W20wt% carbon fibers having 10W15μm fiber diameter and 0.1W0.4mm fiber length, (B) 3W20wt% porous particulate oil coke powder of irregular shape having 30W200μm particle diameter and (C) the remainder of tetrafluoroethylene resin powder having 30W50μm average particle diameter and 10,000W100,000 average molecular weight.

LEGAL STATUS

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[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

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[Claim(s)]
[Claim 1] The member for the sliding sections from which all calcinated the mixed powder with which 3 - 20% of carbon fiber, 3 - 20% of oil coke powder, and the remainder consist of tetrafluoroethylene resin powder, and were obtained by the weight ratio.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[Industrial Application]
This invention relates to the member for the sliding sections. Furthermore, it is related with the member for the sliding sections which made abrasion resistance improve in detail, without containing metal powder as a bulking agent.
[Description of the Prior Art]
Since tetrafluoroethylene resin is excellent in thermal resistance, chemical resistance, a sliding property, etc., it is widely used as a sealant, but since this deformation by external force is large and abrasion loss is also large if independent, blending various fillers with it is performed.
As a filler, although a glass fiber, carbon fiber, metal powder, etc. are used The use examination under severe conditions increases and it is a limiting PV value (a PV value) at the conventional thing in recent years. what is used for expressing a bearing property and serves as a standard of a mutual comparison of bearing material — it is — pressure P Sliding-surface rate V it is expressed functionally, and it excels in pressure resistance and rate-proof nature, so that this value is high — ******** — since it is low, correspondence is becoming impossible to such a demand Moreover, if metal powder is used as a filler, since metal powder is contained in wear powder, fault, such as damaging partner material, may be produced.
[Problem(s) to be Solved by the Invention]
this invention person found out that this technical problem was solved by using oil coke powder as one component of the mixed powder in which calcinate and the member for the sliding sections is made to form, as a result of performing various examination in quest of the approach of making the abrasion resistance of the member for the sliding sections improve, without using the metal powder which may be made to generate such fault.
[Means for Solving the Problem]
Therefore, this invention relates to the member for the sliding sections, and each of these members for the sliding sections calcinates the mixed powder with which 3 - 20% of carbon fiber, 3 - 20% of oil coke powder, and the remainder consist of tetrafluoroethylene resin powder by the weight ratio, and is obtained.
As carbon fiber, the thing whose diameter of single yarn is about 10-15 micrometers and whose fiber length is generally about 0.1-0.4mm is used. Oil coke powder is obtained by grinding the petroleum coke produced in the distillation process of a crude oil, the particle size is about 30-200 micrometers, and the thing of the shape of a porosity particle of an irregular configuration is used. Moreover, as tetrafluoroethylene resin powder, generally, about 30-50 micrometers is used for mean particle diameter, and the thing of about 10,000-100,000 is used for average molecular weight.
The blending ratio of coal between each specified component is the range effective in making the purpose of this invention attain, if each component is used at a rate fewer than this, will reduce a limiting PV value and will come to reduce a mechanical strength at many rate from this.
The mixed powder which consists of each above component puts into the metal mold of a predetermined configuration, after often mixing with a mixer etc., it is preformed under the pressure of about 700 to 900 kgf/cm2, and after this preforming object raises that temperature from a room temperature to 375 degrees C, for example over about 3 hours and holds it at this temperature for about 3 hours, it is carried out as it returns to a room temperature over about 10 hours, and is calcinated all over a firing furnace. A baking object is processed into a desired configuration after that, for example, is fabricated by members for the sliding sections, such as bearing.
[Function] and [Effect]

The member for the sliding sections concerning this invention has the description in the following points.
(1) Since carbon fiber and oil coke powder twine and it reinforces each other, the mechanical property of the obtained member for the sliding sections, for example, compressive strength, a limiting PV value, etc., can be raised.
(2) Minute irregularity is formed in the front face of the member for the sliding sections from carbon fiber and oil coke powder, there is still minuter irregularity also on an oil coke powder front face, since the liquid for lubrication can be made to hold there, the lubrication engine performance is high, and demonstrate the outstanding sliding property.
(3) The thermal resistance of the obtained member for the sliding sections is high, daily use at 260 degrees C is possible for it, and its corrosion resistance is also good. Moreover, since metal powder is not contained in wear powder, fault, such as damaging partner material, is not produced.
[Example]
Next, this invention is explained about an example.
After preforming the mixed powder of the presentation (weight section) shown in examples 1-3, the example 1 of a comparison - the 3 following table by compression forming, it calcinated at 360-380 degrees C for about 3 hours, and the wear multiplier was measured about the baking object. This measurement is 8kg/cm2 of loads, speed 0.5 m / second, time amount 48 hours, and partner material. It was carried out by using a Suzuki style friction abrasion tester to the bottom of the condition of S45C and environmental non-lubrication. The obtained result is shown in the next table.
Table Example Example of a comparison 1 2 3 1 2 3 [a presentation]
Carbon fiber 5 10 15 10 - 5 oil-coke powder 15 10 5 - 20 - artificial graphite - - - - - 15 (mean particle diameter of 100 micrometers or less)
Tetrafluoroethylene resin powder 80 80 80 90 80 80 [a wear multiplier]
10-6cm/(kg/cm2) (m/second) hr 7.3 8.6 10.6 11.3 18.2 28.9 -- as for carbon fiber and oil coke powder, this result shows reducing a wear multiplier in synergistic effect.

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## TECHNICAL FIELD

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[Industrial Application]
This invention relates to the member for the sliding sections. Furthermore, it is related with the member for the sliding sections which made abrasion resistance improve in detail, without containing metal powder as a bulking agent.

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PRIOR ART

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[Description of the Prior Art]
Since tetrafluoroethylene resin is excellent in thermal resistance, chemical resistance, a sliding property, etc., it is widely used as a sealant, but since this deformation by external force is large and abrasion loss is also large if independent, blending various fillers with it is performed.
As a filler, although a glass fiber, carbon fiber, metal powder, etc. are used The use examination under severe conditions increases and it is a limiting PV value (a PV value) at the conventional thing in recent years. what is used for expressing a bearing property and serves as a standard of a mutual comparison of bearing material — it is — pressure P Sliding-surface rate V it is expressed functionally, and it excels in pressure resistance and rate-proof nature, so that this value is high — ******** — since it is low, correspondence is becoming impossible to such a demand Moreover, if metal powder is used as a filler, since metal powder is contained in wear powder, fault, such as damaging partner material, may be produced.

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## EFFECT OF THE INVENTION

[Effect]
The member for the sliding sections concerning this invention has the description in the following points.
(1) Since carbon fiber and oil coke powder twine and it reinforces each other, the mechanical property of the obtained member for the sliding sections, for example, compressive strength, a limiting PV value, etc., can be raised.
(2) Minute irregularity is formed in the front face of the member for the sliding sections from carbon fiber and oil coke powder, there is still minuter irregularity also on an oil coke powder front face, since the liquid for lubrication can be made to hold there, the lubrication engine performance is high, and demonstrate the outstanding sliding property.
(3) The thermal resistance of the obtained member for the sliding sections is high, daily use at 260 degrees C is possible for it, and its corrosion resistance is also good. Moreover, since metal powder is not contained in wear powder, fault, such as damaging partner material, is not produced.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention]
this invention person found out that this technical problem was solved by using oil coke powder as one component of the mixed powder in which calcinate and the member for the sliding sections is made to form, as a result of performing various examination in quest of the approach of making the abrasion resistance of the member for the sliding sections improve, without using the metal powder which may be made to generate such fault.

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MEANS

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[Means for Solving the Problem]
Therefore, this invention relates to the member for the sliding sections, and each of these members for the sliding sections calcinates the mixed powder with which 3 - 20% of carbon fiber, 3 - 20% of oil coke powder, and the remainder consist of tetrafluoroethylene resin powder by the weight ratio, and is obtained.
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The blending ratio of coal between each specified component is the range effective in making the purpose of this invention attain, if each component is used at a rate fewer than this, will reduce a limiting PV value and will come to reduce a mechanical strength at many rate from this.
The mixed powder which consists of each above component puts into the metal mold of a predetermined configuration, after often mixing with a mixer etc., it is preformed under the pressure of about 700 to 900 kgf/cm2, and after this preforming object raises that temperature from a room temperature to 375 degrees C, for example over about 3 hours and holds it at this temperature for about 3 hours, it is carried out as it returns to a room temperature over about 10 hours, and is calcinated all over a firing furnace. A baking object is processed into a desired configuration after that, for example, is fabricated by members for the sliding sections, such as bearing.

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[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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OPERATION

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[Function] — and

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[Translation done.]

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EXAMPLE

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[Example]
Next, this invention is explained about an example.
After preforming the mixed powder of the presentation (weight section) shown in examples 1-3, the example 1 of a comparison - the 3 following table by compression forming, it calcinated at 360-380 degrees C for about 3 hours, and the wear multiplier was measured about the baking object. This measurement is 8kg/cm2 of loads, speed 0.5 m / second, time amount 48 hours, and partner material. It was carried out by using a Suzuki style friction abrasion tester to the bottom of the condition of S45C and environmental non-lubrication. The obtained result is shown in the next table.
Table Example Example of a comparison 1 2 3 1 2 3 [a presentation]
Carbon fiber 5 10 15 10 - 5 oil-coke powder 15 10 5 - 20 - artificial graphite - - - - - 15 (mean particle diameter of 100 micrometers or less)
Tetrafluoroethylene resin powder 80 80 80 90 80 80 [a wear multiplier]
10-6cm/(kg/cm2) (m/second) hr 7.3 8.6 10.6 11.3 18.2 28.9 — as for carbon fiber and oil coke powder, this result shows reducing a wear multiplier in synergistic effect.

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[Translation done.]